FOSTERING INTEREST IN INTERDISCIPLINARY INQUIRY-BASED SCIENCE CAMPS

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SCICAMP Final Conference | Berlin

Outline

- Interest in Science and Mathematics
- Rationale for Integration of Mathematics and Science
- Design & Sample
- Learning Environment
- Students‘ interest
- Students‘ view of relation between mathematics and science

Scientific Literacy as the aim of Science Education

"For the purposes of PISA, scientific literacy refers to an individual's:

- **Scientific knowledge and use of that knowledge** to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues.
- **Understanding** of the characteristic features of science as a form of human knowledge and enquiry.
- **Awareness** of how science and technology shape our material, intellectual and cultural environments.
- **Willingness to** engage in science-related issues, and with the ideas of science, as a reflective citizen." (OECD 2012, 100)

Rationale for Integration of Mathematics and Science

- Real world is not separated
- Needs and interest of students are better served
- M & S are based on interdependent ways of knowing:
  - Similar attempts to discover patterns and relationships
  - Mathematics quantifies and models science phenomena
  - M & S share similar processes and content
- M & S are learned in a similar way

(Czerniak et al. 1999; Pang and Good 2000; Berlin et al. 2005; Berlin et al. 2012; Bossé et al. 2010; So 2013)

Explication of Mathematics in Science …

… is a form of integration, where students learn and use concepts and skills related to both mathematics and science, to examine a central theme.

(Jacobs 1989, Lonning and DeFranco 1997)

Evidence: Mathematics and Science are connected in Scientific Inquiry

- Tables, graphs, and equations are frequently used in science and mathematics
  - to communicate,
  - to reveal patterns
  - to construct understanding
  - to persuade others about this understanding
  - to report this understanding

(Potgieter et al. 2008)

- Measurement is used to plan and carry out investigations;
- Numeracy skills are used to collect, analyze, and interpret data;
- Graphs and tables are used to organize and interpret quantitative information, as well as to visualize data for pattern and trend presentation.

(So 2013)

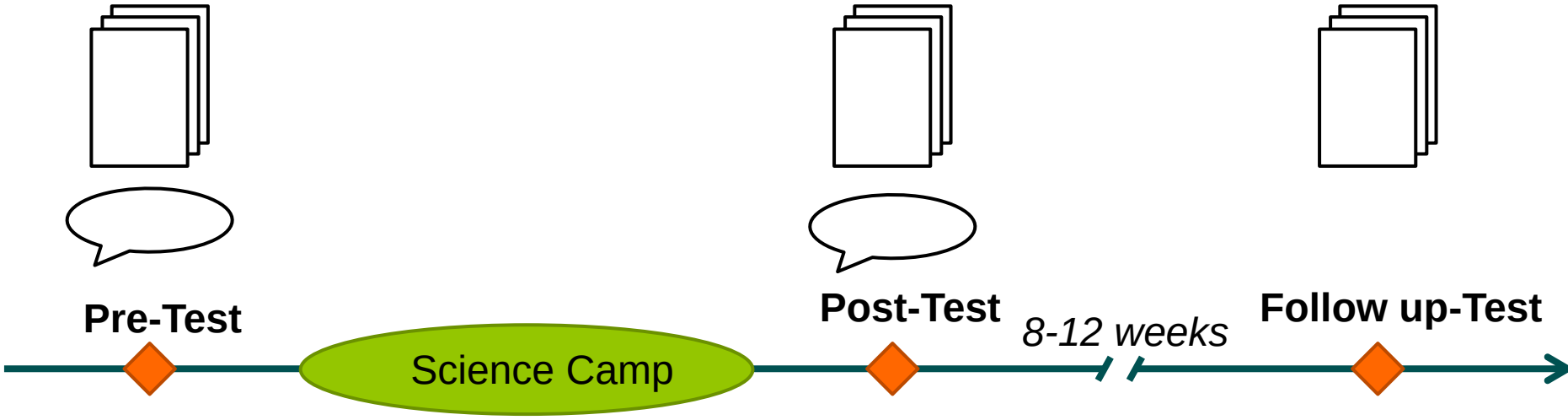
Aim of the study is to

Examine the effects of engaging in an inquiry-based science learning environment that explicates mathematics on students‘

(1) interest in science and mathematics

(2) view of the relation between mathematics and science.

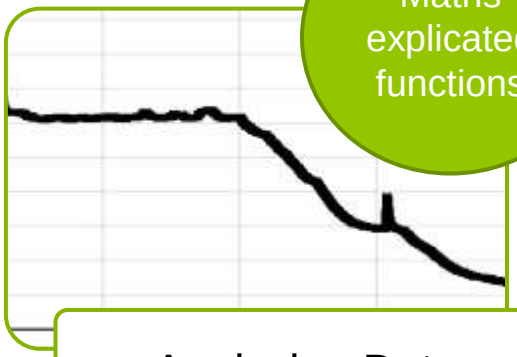
Design of Study



Treatment Groups	Climate Change	Alternative Science Topics
Mathematics is explicated	x	
Mathematics is implicit	x (Control Group)	x

Learning environment about Climate Change

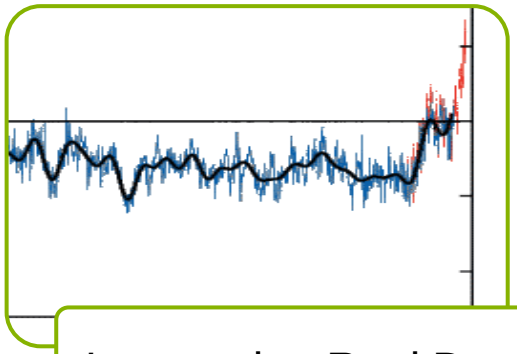
Planning & Conducting Experiments



Maths explicated functions

Analysing Data

Deducing & Explaining Phenomena



Interpreting Real Data

Sample

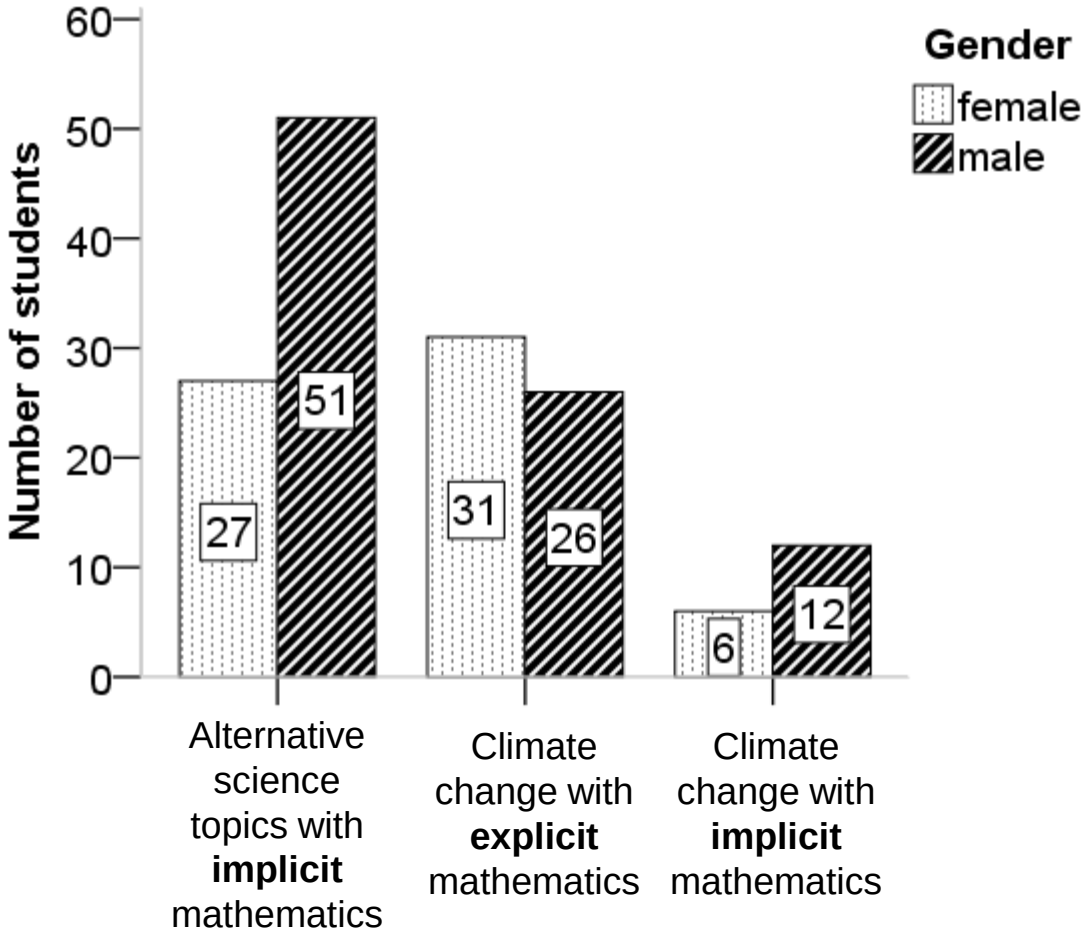
Participants from grade 6 to 11

Mean of grades:

Altenative topics: 7.97 (SD = 1.3)

Climate change with explicit maths: 8.18 (SD = 1.3)

Climate change: 7.67 (SD = 1.1)



Constructivist Characteristics of the Learning Environments

	Total (N =153)	CM (N =57)	CO (N =18)	A (N =78)	Pawek (N =734)
	$\bar{x}$ (σ)	$\bar{x}$ (σ)	$\bar{x}$ (σ)	$\bar{x}$ (σ)	$\bar{x}$ (σ)
Every-day relevance	.70 (.02)	.72 (.19)	.73 (.19)	.67 (.19)	.68 (.20)
Authenticity	.73 (.19)	.74 (.21)	.77 (.18)	.72 (.18)	.68 (.18)
Active engagement	.75 (.18)	.77 (.17)	.73 (.17)	.74 (.19)	.64 (.19)
Challenge	.56 (.19)	.49 (.20)	.55 (.17)	.60 (.18)	.50 (.22)
Openness	.80 (.20)	.76 (.20)	.69 (.25)	.87 (.15)	.65 (.24)
Comprehensibility	.79 (.13)	.81 (.12)	.79 (.09)	.77 (.14)	.74 (.14)

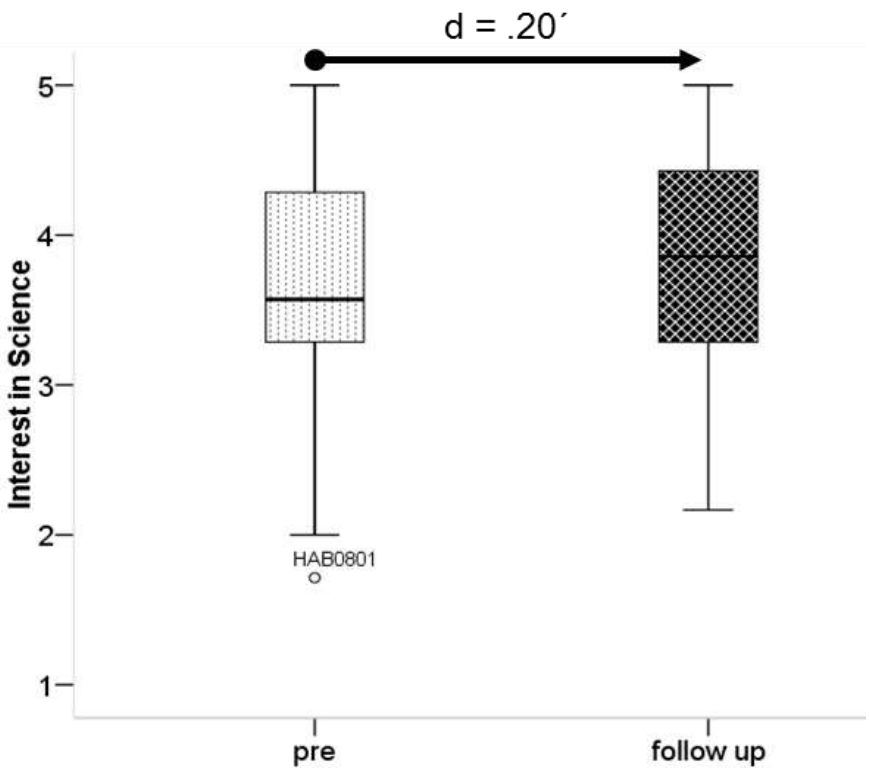
Interest in Science

7 items (Pawek 2009) ranked on a 5 point Likert-Scale from 1/"Completely wrong" to 5/"Completely correct".

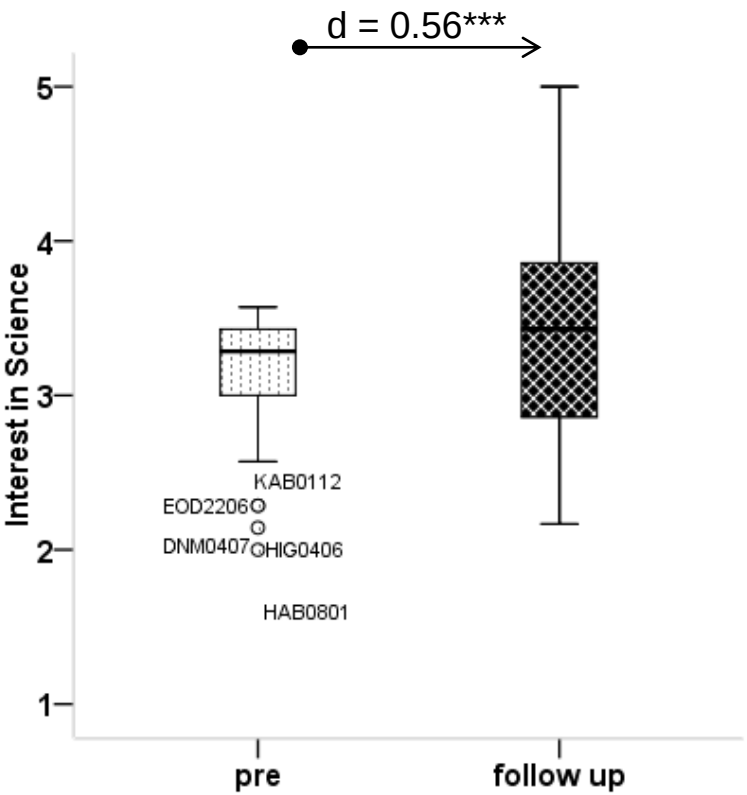
Cronbach's alpha: pre .82 and post .83

N = 107

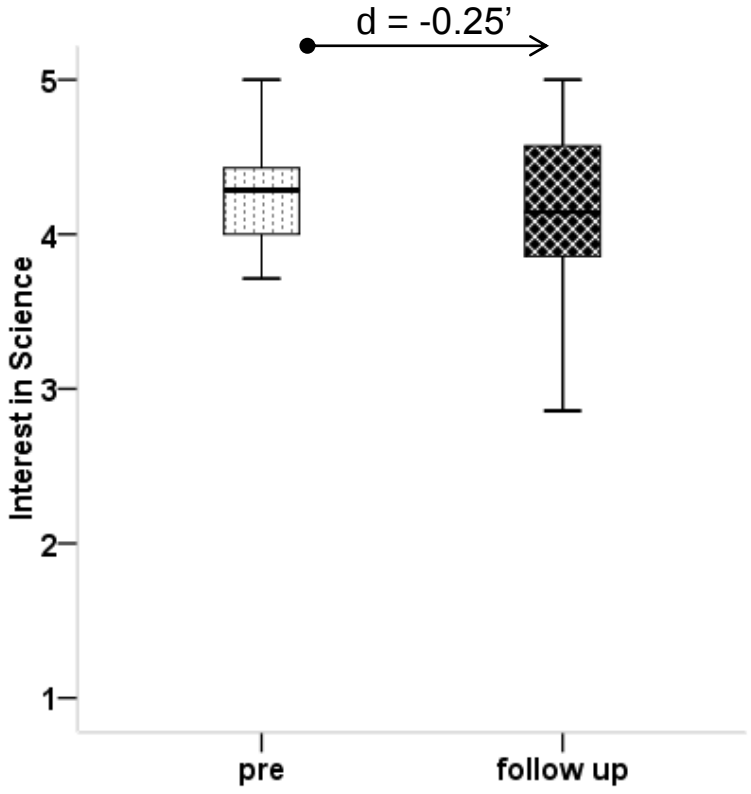
Cohen's d is sigfinicant to a level of p=.066 ≤ .1.



Split half: Interest in Science



Lower group
N = 54
M = 3.09 (*SD* = .47)



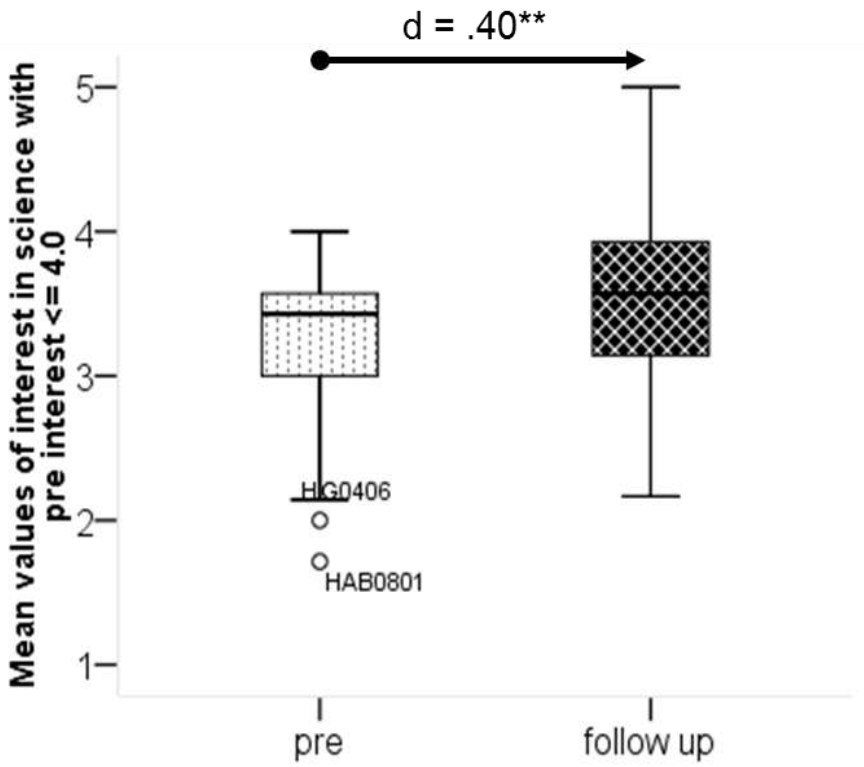
Upper group
N = 53
M = 4.23 (*SD* = .35)

Interest in Science of Lower Subgroup

N = 71

Pre interest ≤ 4.0

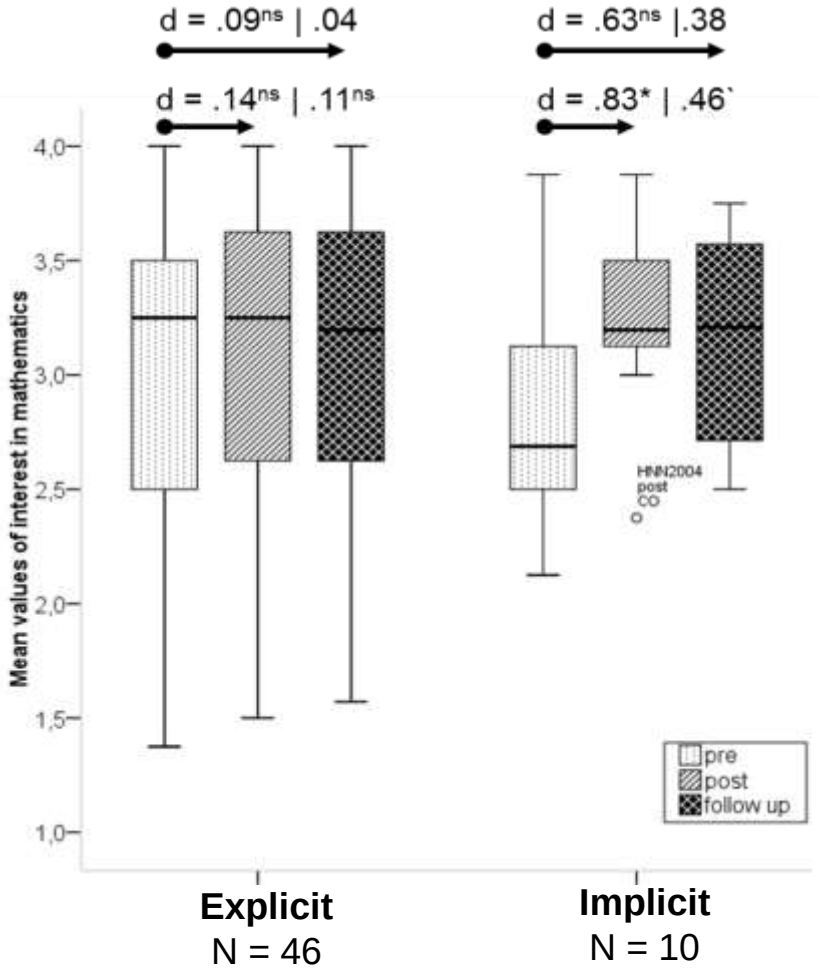
Cohen's d is signficant to a Level of p=.004 ≤ .01.



Interest in Mathematics

8 items scale (Rakoczy et al. 2005) ranked on a 4 point Likert Scale from 1 „totally disagree“ to 4 „totally agree“

Cronbach‘s alpha: pre .90; post .92; follow up .93

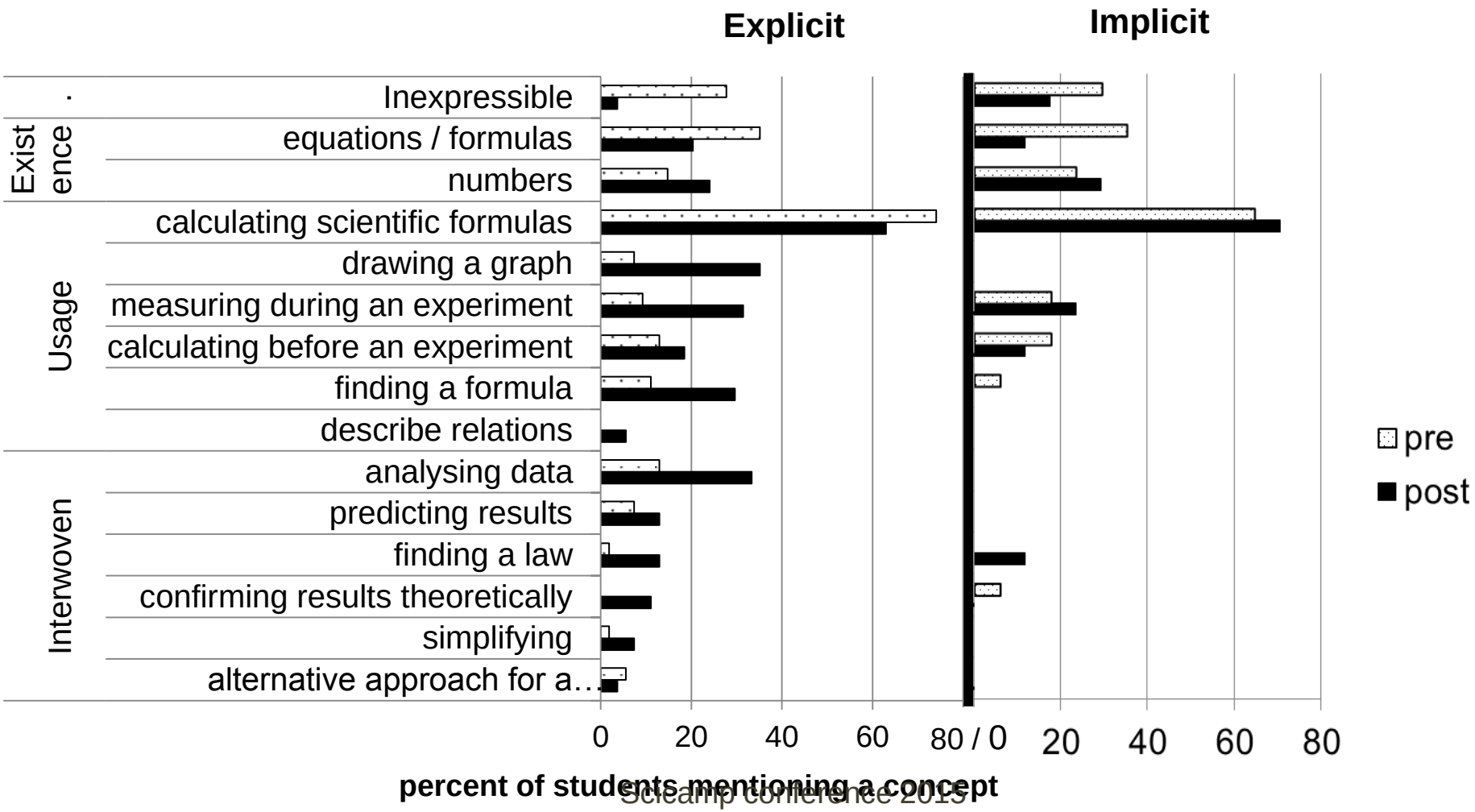


Comparing Gain Scores

	Explicit		Implicit		Explicit Gain Score Mean (SD)	Implicit Gain Score Mean (SD)	Mann-Whitney U test	
	N	Mean (SD)	N	Mean (SD)			Z	p
Pretest	57	3.08 (.66)	17	2.97 (.53)	.08 (.34)	.24 (.43)	-1.19	.240
Posttest		3.16 (.69)		3.21 (.52)				
Pretest	46	3.05 (.66)	10	2.84 (.56)	.06 (.45)	.31 (.60)	-1.51	.135
Follow up Test		3.11 (.69)		3.15 (.43)				

View of the relation between mathematics and science

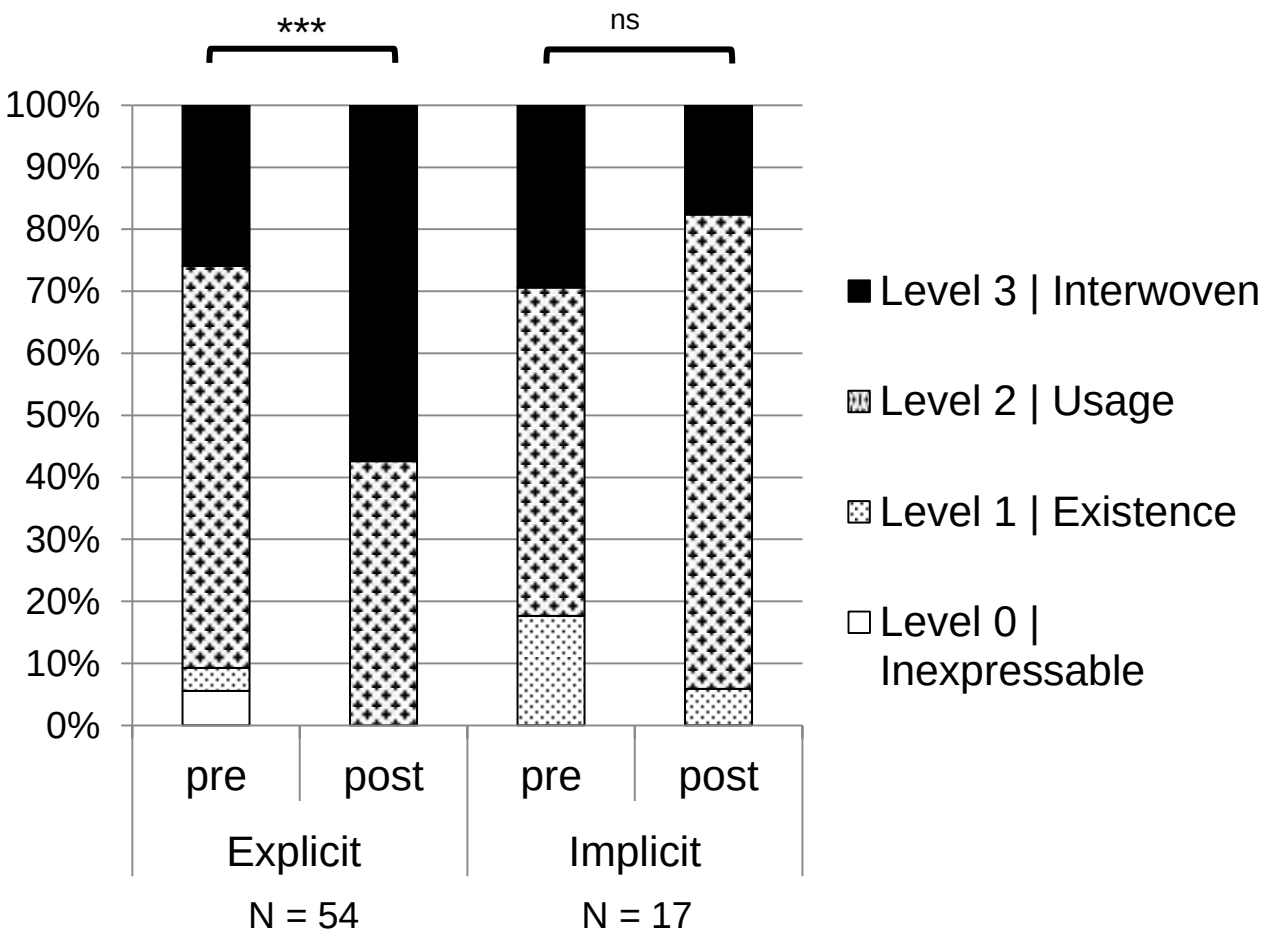
Subcategories of the relation between mathematics and science



Distribution of categories depending on the treatment

Reliability tested by accordance between first and second rater

Kendall‘s W = 0.84*



Summary

- Interest in science can be fostered by IBSL.
- Interest in mathematics is fostered by IBSL but not by explication of mathematics in science.
- Students can perceive the connections of mathematics and science.
- Explication of mathematics in IBSL can lead to a more elaborated view of the relation between mathematics and science.

sdw
Stiftung der Deutschen Wirtschaft
Wir stiften Chancen!

MARTIN-LUTHER-UNIVERSITÄT
HALLE-WITTENBERG

Thank you!

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